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Comment

Invasion costs, impacts, and human agency: Response to Sagoff 2020

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Introduction

The increasing relevance of invasion science in an era of profound biodiversity loss (Simberloff et al. 2013) has been accompanied by an increase in denialism that exploits uncertainty, ignores or misrepresents empirical evidence, alleges bias, and casts doubt on consensus (Russell & Blackburn 2017; Pauchard et al. 2018; Ricciardi & Ryan 2018*a*,*b*). Evidence-based scientific debate (i.e., informed skepticism) indicates a healthy discipline; however, repeating unsupported claims and disregarding decades of evidence negates knowledge progression, adversely affects public attitudes, and misleads policy makers. Sagoff (2020) ignores a large empirical evidence base

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and dismisses consensus among invasion scientists by questioning: the credibility of high economic costs of invasive species; threats posed by invasive species other than predators; generality of native and nonnative distinctions; and, the utility of ontological dualism in distinguishing natural and anthropogenic processes.

Underestimation of Economic Costs of Invasions

Sagoff bemoans unequivocal acceptance of cost estimations in Pimentel et al. (2000, 2005). Although highly cited owing to a previous lack of invasion cost estimates, Pimentel's figures are not the key area of consensus that Sagoff implies (e.g., Holmes et al. 2009; Perrings 2011). Sagoff ignores more recent economic works that explicitly consider damage-related costs (Bradshaw et al. 2016; Paini et al. 2017; van Wilgen and Wilson 2018). Moreover, Diagne et al.'s (2020) estimates of global invasion costs are likely to supersede Pimentel's results. Nevertheless, vast data gaps generally observed in monetary evaluations suggest Pimentel's calculations are massively underestimated (Bradshaw et al. 2016).

Sagoff also questions the inclusion of control costs and insinuates that they benefit management agencies more than the public. Such assertions discount myriad nonmarket economic benefits to the public of invasive species management (e.g., quantifiable via revealed preference methods [Hanley & Roberts 2019]). Private entities and nongovernmental organizations, particularly those with commercial imperatives (e.g., agriculture and forestry), have little to gain from inefficient expenditure to control invasive species. Furthermore, Sagoff ignores the reality that control protocols are essential to preventing or mitigating damage and are substantially less costly than damage (Kettunen et al. 2009).

Damage by Nonpredatory Species

Sagoff mistakes the number of extinctions attributed to invasive plants by mischaracterizing the results of Blackburn et al. (2019), who found that nonnative species are the sole or contributing cause of 25% and 33% of plant and animal extinctions, respectively, whereas native species contribute to 3–5% of extinctions and are never the sole cause. Contrary to Sagoff's description, Blackburn et al. (2019) made no comment on the role of nonnative plants in these extinctions; however, invasive plants can damage biodiversity (Pyšek et al. 2012) and contribute to extinction risk (Baider & Florens 2011; Downey & Richardson 2016). Invasions may interact with other drivers of extinction to exacerbate ecological impacts, such as habitat alteration, and synergisms among these processes must be considered.

By focusing on global extinction as a sole metric for ecological impact, Sagoff ignores a broad range of invader effects on biodiversity for which extinction constitutes only an extreme result (Simberloff et al 2013; Downey & Richardson 2016; Russell & Kueffer 2019). Certain native species (e.g., pollinators) have a disproportionate influence on community structure and ecosystem function, and declines in their abundance have substantial impacts. Invasions can substantially reduce biodiversity through competition (e.g., plants), hybridization (e.g., trout), changes to ecosystem structure and function (e.g., mussels and nitrogen-fixing plants), and disease transmission (e.g., chytrid in amphibians). Such cases are well documented in the scientific literature.

Evidence for Biological Differences between Invasive and Native Species

Sagoff ignores multiple biological characteristics correlated with invader success and impact (e.g., van Kleunen et al. 2010; Dick et al. 2017; Cuthbert et al. 2019). Research on trait-based profiling of species has been so extensive that it usefully predicts future invaders for many taxonomic groups, including plants, fungi, insects, fish, reptiles, and mammals (Fournier et al. 2019). Furthermore, Sagoff's dismissal of co-evolutionary pressures in communities resulting in stability and drastic impacts (e.g., novel predators on islands) is misinformed, and he appears to confuse modifications within species with clearly observed evolutionary pressures that derive from other community members (Abrams 2000).

Sagoff asserts that a lack of historical information makes discrimination of invaded and uninvaded ecosystems impossible. In many scientific fields (not least conservation), a static image provides challengingly insufficient information to infer dynamic processes. This challenge is equally acute in invasion science, which is based on historical relationships between community components. Although invaded communities can still function in a general sense, the transition from one functioning type to another through the loss of taxonomic, phylogenetic, and functional biodiversity can fundamentally disrupt ecosystems (Holitzki et al. 2013; Russell & Kueffer 2019). In other cases, it is less obvious how changes in community composition translate to ecosystem functioning, but this does not mean there are no differences between invaded and uninvaded systems. By suggesting that every invasion should be easily identifiable, Sagoff undermines the level of scientific expertise that underpins ecology.

Relevance of a Human–Nature Dualism

Sagoff claims that because key concepts of invasion science mention the notion of human assistance, "invasion biology must divide human beings…from the rest of nature as separate kinds of agencies," which leads him to the platitude that ontological dualism has no biological basis. This interpretation is too literal. Invasion scientists' use of human agency to define invasive species does not mean they believe that humans are not a product of evolution or that laws of genetics, anatomy, and physiology do not hold true for humans. This idea is not anchored in any ontological dualism. It simply asserts that because human activities are a key causal factor in invasions of some species, people should be responsible for their actions—these impacts—and should try to stop or mitigate them.

To abolish the nature–culture distinction is a classic attempt to disempower and depoliticize conservation issues. If everything were considered natural, including effects of human activities, all damage caused by humans to the natural world would not be problematic and would not warrant reparation or cessation. Thus, negating this distinction also negates the values associated with the defense of nature, in this instance, working against the establishment of invasive populations introduced by humans that devastates or threatens other species. That natural is here opposed only to supernatural and not to the more banal artificial is a polemic device that negates any detrimental consequences of human activity. It is just as cynical as claiming that massive oil slicks, deforestation, and human-induced climate change are natural events and therefore should not be addressed.

Conclusion

Sagoff's points constitute 4 misinformed claims concerning fact and value in invasion science. The enormous economic costs, ecological impacts of nonpredatory species, differences between native and nonnative, and distinctions between natural and anthropogenic are supported by evidence and represent expert consensus. Nonetheless, alleging that invasion science has reached consensus on only these areas downplays progress in the discipline. Sagoff's accusation that "citations that circle around to self-citations, and citations that do not support the text, are speculation. Repetition, not evidence, corroborates these estimates…" is ironic, given that his articles exhibit a clear pattern of self-citation and repetition of unsubstantiated arguments (Ricciardi & Ryan 2018*b*). In contrast to informed sceptics who advance science, denialists mislead scientists, stakeholders, and policy makers by repeating debunked claims (Petersen et al. 2019). We urge journal editors to reconsider acceptance of denialist essays, despite potential boosts to impact factor.

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